eyenne, Wyoming

ER RECHARGE STUDY

EASTERN WYOMING

est Regional Commission

rant No. 10470021

PLATE I

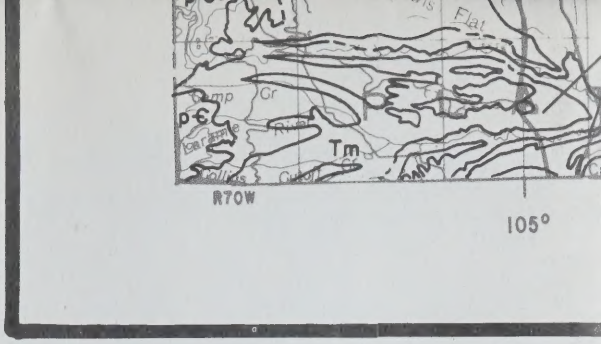
ACE GEOLOGY MAP

HEASTERN WYOMING

June, 1976

Project Leader A.J. Mancini

Drafted by D.E. Woodhams



10 0

10 0

Black Hills Uplift

		Wyoming *		South Dakota
	Tertiary	Tmo		Twr
		Tw		
		Tfu		
		Ti		Ti
MESOZOIC	Cretaceous	Kh-l		
		Kfh		
		K		K
		Kd		Kjm
		Kjm ?		
	Jurassic-Triassic	J-Ŧ		J-Ŧ
PALEOZOIC	Permian	P		ℙml
	Permian-Pennsylvanian	ℙh	ℙml	
	Mississippian (and Devonian)	Mpe		Mpe
	Ordovician and Cambrian	O €		€
	Precambrian	p-€		p-€

Tmo Miocene and Oligocene Rocks

Tw Wasatch Formation

Tfu Fort Union Formation

Ti Igneous Rocks

Kh-l Hell Creek–Lance Sequence Undivided

Kfh Fox Hills Sandstone

K Cretaceous Rocks below Fox Hills and above Dakota, Undivided

Kd Fall River Sandstone (Dakota) and Lakota Conglomerate

Kjm Undivided Cretaceous Dakota Sandstone, Cloverly Formation, and Jurassic Morrison Formation.

J-Ŧ Undivided Jurassic–Triassic Rocks

P Permian Rocks above Hartville Formation or Equivalent

ℙh Permian–Pennsylvanian Hartville Formation

ℙml Minnelusa Formation

Mpe Pahasapa and Englewood

O € Ordovician-Cambrian Rocks Undivided

p€ Precambrian Igneous and Metamorphic Rocks

* And adjacent eastern Powder River Basin.

Twr Whit

Ti Igneo

K Creta but Gree mat

Kjm Cret uding Form Rive

J-Ŧ Trias ding

ℙml Penn incl tion

Mpe Miss incl Whi nian

€ Cam

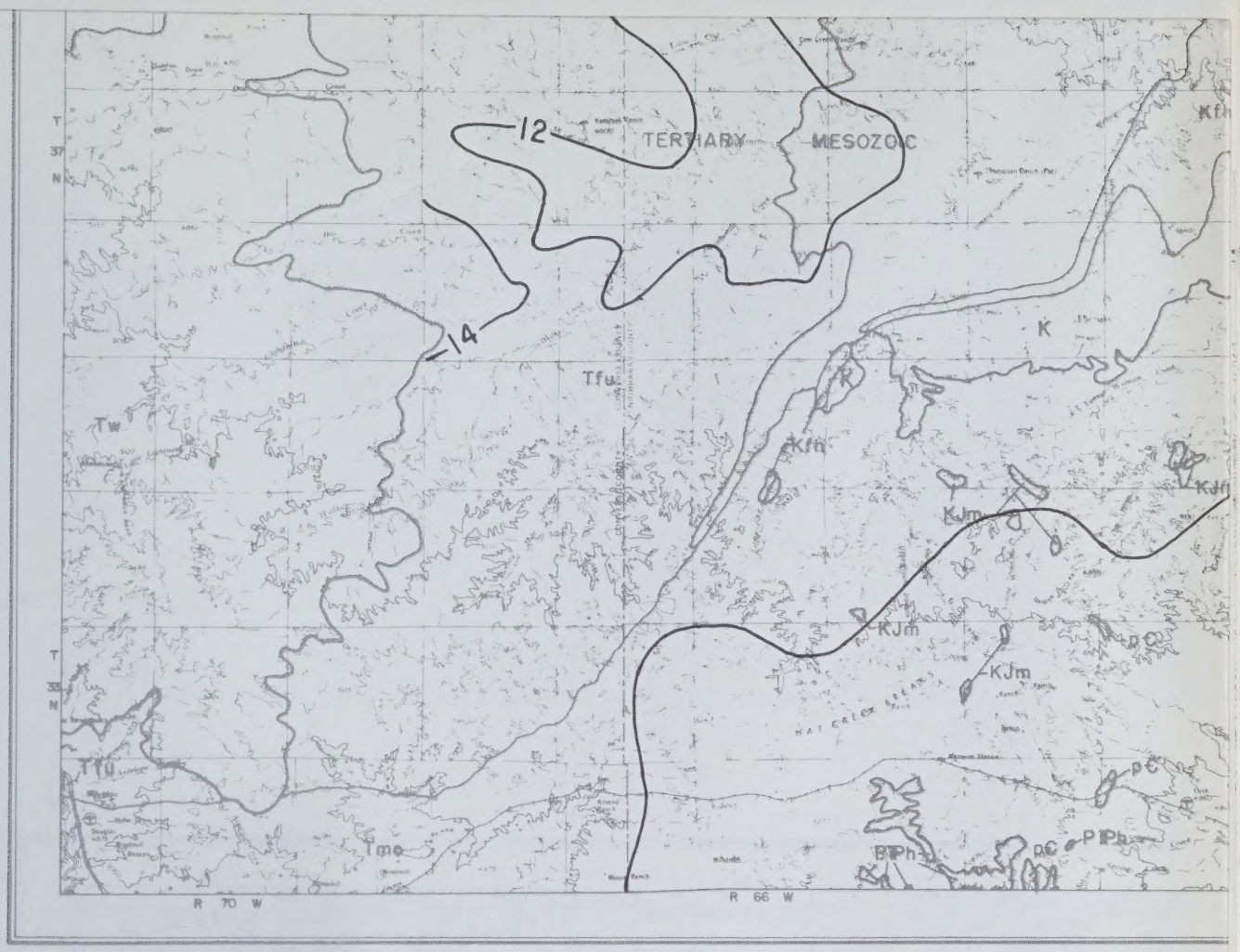
p€ Prec phic

(From S.D.

GEOLOGY

NOT SHOWN

MONTANA
SOUTH DAKOTA
NORTH DAKOTA
SHERIDAN
JOHNSON
CAMPBELL
CONVERSE
NIOBRARA
WESTON
CROOK
WASHAKIE
NATRONA
GOSHEN
PLATTE
BIG HORN
Buffalo
Gillette
CASPER
Worland
Thermopolis
Lusk
Newcastle
Sundance
Douglas
Wheatland
Torrington
Lingle
Guernsey
Hartville
Lusk
Van Tassell
Prairie Center
Jay Em
Meadowdale
Mountain View
Alcova
Natrona
Powder River
Raderville
Ralston Flats
Meriam Meadows
Waltman
Hells Half Acre
Poison Spider
Red Butte Hills
Paradise Valley
Casper Mountain
Muddy Gap
Arminto
Orin
Orin Junction
Sussex
Midwest
Edgerton
Salt Creek
Bear Creek
Dry Creek
Cow Creek
Lance Creek
Dull Center
Manville
Lusk
Node
Keeline
Fisher
Meadowdale
Clay Spur
Jay Em
Prairie Center
Van Tassell
Spoon Butte
Granite Mountains
Seminoe Mountains
Shirley Mountains
Laramie Mountains
Hartville Uplift
Black Hills Uplift
Oregon Basin
Elk Basin
Beaver Rim
Casper Arch
Powder River Basin
Hanna Basin
Shirley Basin
Laramie Basin
Denver Basin
Cheyenne River
Belle Fourche River
Niobrara River
Platte River
Powder River
Tongue River
Big Horn River
Wind River
Bighorn River
Little Missouri River
Grass Creek
Hamilton Dome
Thermopolis
Kirby
Worland
Hyattville
Manderson
Ten Sleep
Buffalo
Sheridan
Big Horn
Parkman
Monarch
Story
Banner
Dayton
Ranchester
Big Goose
Tongue River
Wolf
Acme
Decker
Kane
Lovell
Garland
Basin
Greybull
Otto
Emblem
Burlington
Manderson
Ten Sleep
Hyattville
Kirby
Thermopolis
Hot Springs
Owl Creek
Meeteetse
Cody
Powell
Deaver
Frannie
Garland
Basin
Lovell
Kane
Big Horn
Parkman
Monarch
Story
Banner
Dayton
Ranchester
Big Goose
Tongue River
Wolf
Acme
Decker
Sheridan
Buffalo
Kaycee
Barnum
Mayoworth
Powder River
Arvada
Clearmont
Recluse
Moorcroft
Sundance
Aladdin
Hulett
Alva
Beulah
Reuter
Pine Tree
Tumbleweed
Rochelle
Thunder
Claredon
Verse
Ross
Riverview
Dull Center
Lance Creek
Bright
Redbird
Cow Creek
Bill
Janet
Lance
Whitman
Kurtley
Van Tassell
Prairie Center
Jay Em
Meadowdale
Clay Spur
Jerome
Horton
Thornton
Keeline
Node
Fisher
Meadowdale
Lusk
Manville



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Cheyenne, Wyoming

GROUNDWATER RECHARGE STUDY

NORTHEASTERN WYOMING

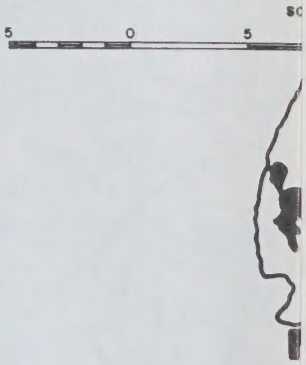
Old West Regional Commission

Grant No. 10470021

PLATE 2

GEOLOGY AND PRECIPITATION MAP OF THE BLACK HILLS UPLIFT

JUNE, 1976



See Plate 1 for ge
and Plate 13 for i

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Grant No. 10470021

PLATE 2
GEOLOGY AND PRECIPITATION
MAP OF THE BLACK HILLS
UPLIFT

JUNE, 1976

See Plate 1 for geology information and Plate 13 for isohyetal interval.

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NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

JUNE, 1976

PLATE 3

EAST FLANK BIG HORN MOUNTAINS

TONGUE RIVER DRAINAGE AND ADJACENT AREAS - 45°N. TO 44°37'30"N.

Compiled by Wyoming Water Resources Research Institute for the Wyoming State Engineer's Office.
Based on work funded by the Office of Water Research and Technology.

R. 86 W.

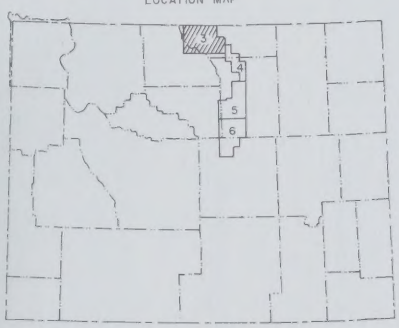
T. 58 N.

T. 57 N.

T. 56 N.

N

LOCATION MAP



WYOMING

SCALE

0 1 2 3 4 5miles

LEGEND

ROCK UNITS

Qal	Quaternary Alluvium
Qls	Quaternary landslide deposits
TQu	Undifferentiated Tertiary and Quaternary Rocks
PMu	Undifferentiated post-Tensleep Rocks
IPt	Tensleep Sandstone
MIPta	Undivided Tensleep and Amsden Rocks
MIPa	Amsden Formation
Mm	Madison Limestone
DMm	Undivided Madison Limestone and Jefferson Dolomite
Ob	Bighorn Dolomite
€u	Undifferentiated Cambrian Rocks
p€u	Undifferentiated Precambrian Rocks

SYMBOLS

U/D — Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side

Anticline, shows trace axial plane and direction of plunge

13 — Strike and dip of beds, 13-dip of beds in degrees

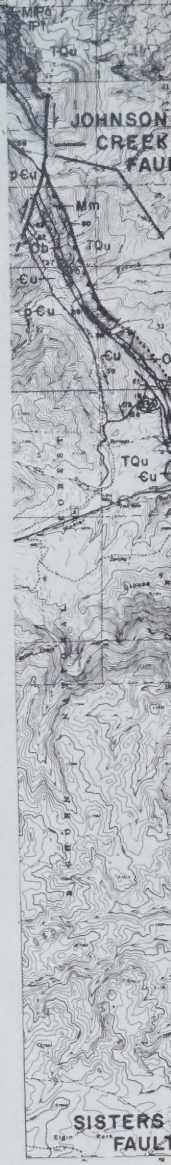
Dayton

IPt

PMu

Tongue River System

WYOMING STATE ENGINEER
Cheyenne, Wyoming
GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021
JUNE, 1976
PLATE 3
EAST FLANK BIG HORN MOUNTAINS
TONGUE RIVER DRAINAGE AND ADJACENT AREAS- 45°N. TO 44°37'30"N.
Compiled by Wyoming Water Resources Research Institute for the Wyoming State Engineer's Office.
Based on work funded by the Office of Water Research and Technology.
LEGEND
ROCK UNITS
Qal Quaternary Alluvium
Qs Quaternary landslide deposits
TQu Undifferentiated Tertiary and Quaternary Rocks
PMu Undifferentiated post-Tongue Rocks
Pt Tongue Sandstone
MPtu Undivided Tongue and Amsden Rocks
MPa Amsden Formation
Mm Madison Limestone
Dlm Undivided Madison Limestone and Jefferson Dolomite
Dj Jefferson Dolomite
Cu Undifferentiated Cambrian Rocks
pCu Undifferentiated Precambrian Rocks
SYMBOLS
Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side
Anticline, shows trace axial plane and direction of plunge
Strike and dip of beds, 13-dip of beds in degrees
LOCATION MAP
WYOMING
SCALE
Miles
Northeastern Sector
Southwestern Sector
NORTHERN BIG HORN MOUNTAINS
CENTRAL BIG HORN MOUNTAINS
Tongue River System
PRECAMBRIAN ROCKS WITH LOCAL TERTIARY DEPOSITS
NOT MAPPED
TONGUE RIVER FAULT ZONE
SOUTH TONGUE RIVER FAULT ZONE
DOWNEY CREEK FAULT
R. 89 W.
R. 88 W.
R. 87 W.
R. 86 W.
R. 91 W.
R. 90 W.
R. 89 W.
R. 88 W.
R. 87 W.
R. 86 W.
R. 85 W.
T. 58 N.
T. 57 N.
T. 56 N.
T. 55 N.
T. 54 N.



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Cheyenne, Wyoming
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NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

JUNE, 1976

PLATE 4

EAST FLANK BIG HORN MOUNTAINS
CLEAR CREEK DRAINAGE AND ADJACENT AREAS
44°37'30"N. TO 44°15'N.

Compiled by Wyoming Water Resources Research Institute
for the Wyoming State Engineer's Office.

Based on work funded by the Office of Water Research and Technology.

LEGEND

ROCK UNITS

TQu	Undifferentiated Tertiary and Quaternary Rocks
PMu	Undifferentiated post-Tensleep Rocks
IPt	Tensleep Sandstone
MPa	Amsden Formation
Mm	Madison Limestone
DMm	Undivided Madison Limestone and Jefferson Dolomite
Ob	Bighorn Dolomite
€u	Undifferentiated Cambrian Rocks
p€u	Undifferentiated Precambrian Rocks

SYMBOLS

U/D — Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side

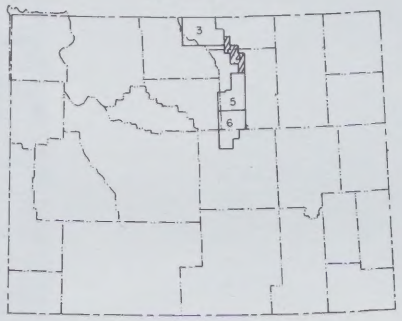
Thrust fault, dotted where inferred, teeth on upper plate

Anticline, shows trace of axial plane and direction of plunge

Syncline, shows trace of axial plane and direction of plunge.

13 — Strike and dip of beds, 13-dip of beds in degrees

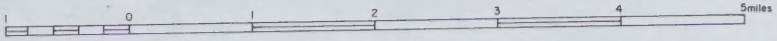
LOCATION MAP

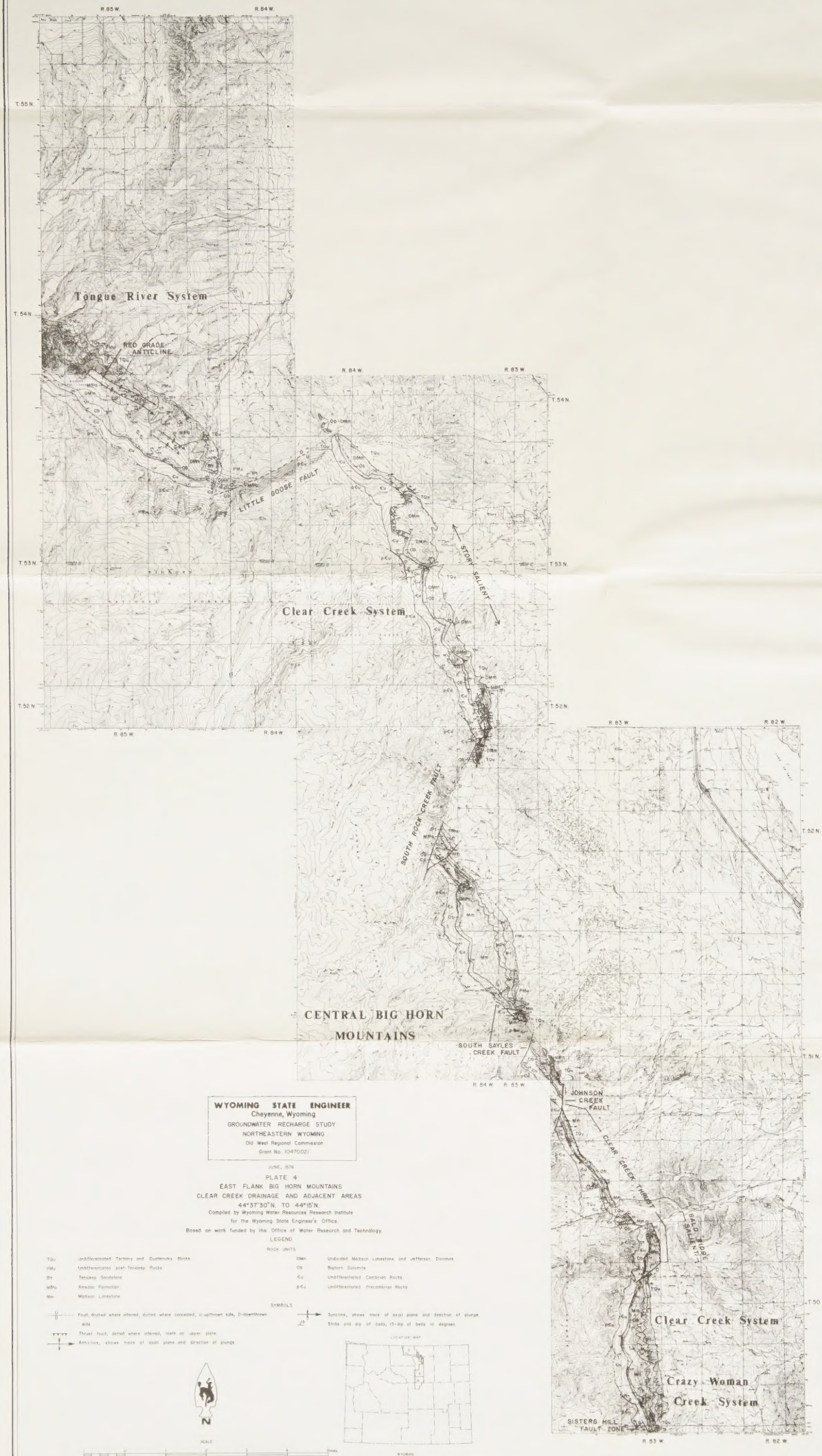


WYOMING

N

SCALE




R.85 W.
R.84 W.
R.83 W.
R.82 W.
T.55 N.
T.54 N.
T.53 N.
T.52 N.
T.51 N.
T.50 N.
Tongue River System
RED GRADE ANTICLINE
LITTLE GOOSE FAULT
STORY SALIENT
Clear Creek System
SOUTH ROCK CREEK FAULT
CENTRAL BIG HORN MOUNTAINS
SOUTH SAYLES CREEK FAULT
JOHNSON CREEK FAULT
CLEAR CREEK THRUST
BALD RIDGE SALIENT
Clear Creek System
Crazy Woman Creek System
SISTERS HILL FAULT ZONE
WYOMING STATE ENGINEER
Cheyenne, Wyoming
GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021
JUNE, 1976
PLATE 4
EAST FLANK BIG HORN MOUNTAINS
CLEAR CREEK DRAINAGE AND ADJACENT AREAS
44°37'30"N. TO 44°15'N.
Compiled by Wyoming Water Resources Research Institute
for the Wyoming State Engineer's Office.
Based on work funded by the Office of Water Research and Technology.
LEGEND
ROCK UNITS
TQu Undifferentiated Tertiary and Quaternary Rocks
TKfu Undifferentiated post-Tensleep Rocks
IPt Tensleep Sandstone
MPu Amsden Formation
Mm Madison Limestone
DMm Undivided Madison Limestone and Jefferson Dolomite
Db Bighorn Dolomite
Cu Undifferentiated Cambrian Rocks
pCu Undifferentiated Precambrian Rocks
SYMBOLS
Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side
Thrust fault, barbed where inferred, teeth on upper plate
Anticline, shows trace of axial plane and direction of plunge
Syncline, shows trace of axial plane and direction of plunge
Strike and dip of beds, 15-dip of beds in degrees
LOCATION MAP
WYOMING
N
SCALE

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GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING

Old West Regional Commission
Grant No. 10470021

JUNE, 1976

PLATE 5

EAST FLANK BIG HORN MOUNTAINS DRAINAGES OF CRAZY WOMAN CREEK AND NORTH FORK POWDER RIVER AND ADJACENT AREAS – 44°15'N. TO 43°45'N.

COMPILED BY
Peter Huntoon
James W. Sears
Bruce D. Wilson
R.M. Wolf
WYOMING WATER RESOURCES RESEARCH INSTITUTE

LEGEND

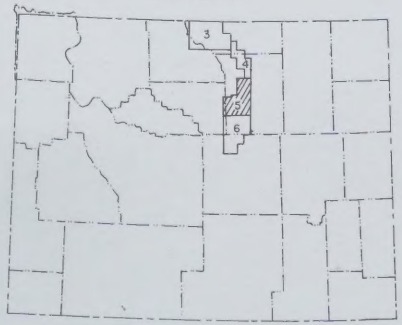
ROCK UNITS

TQu	Undifferentiated Tertiary and Quaternary Rocks
PMu	Undifferentiated post-Tensleep Rocks
PPt	Tensleep Sandstone
MPa	Amsden Formation
Mm	Madison Limestone
Ob	Bighorn Dolomite
€u	Undifferentiated Cambrian Rocks
p€u	Undifferentiated Precambrian Rocks

SYMBOLS

- U/D — Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side
- Thrust fault, dotted where inferred, teeth on the upper plate
- Anticline, shows trace of axial plane and direction of plunge
- 13 — Strike and dip of beds, 13-dip of beds in degrees

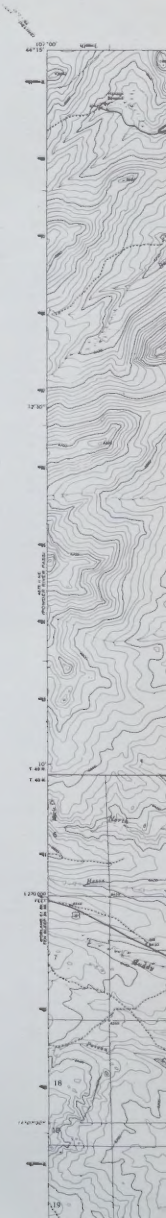
LOCATION MAP



WYOMING

SCALE

1 0 1 2 3 4 5miles



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GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

JUNE, 1976

PLATE 5
EAST FLANK BIG HORN MOUNTAINS
DRAINAGES OF CRAZY WOMAN CREEK AND
NORTH FORK POWDER RIVER AND ADJACENT
AREAS – 44°15'N. TO 43°45'N.

COMPILED BY
Peter Huntoon
James W. Sears
Bruce D. Wilson
R.M. Wolf
WYOMING WATER RESOURCES RESEARCH INSTITUTE

LEGEND

ROCK UNITS

TQu	Undifferentiated Tertiary and Quaternary Rocks
PNu	Undifferentiated post-Tensleep Rocks
Py	Tensleep Sandstone
MPm	Amsden Formation
Mm	Madison Limestone
Ob	Bighorn Dolomite
€u	Undifferentiated Cambrian Rocks
p€u	Undifferentiated Precambrian Rocks

SYMBOLS

Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side

Thrust fault, dotted where inferred, teeth on the upper plate

Anticline, shows trace of axial plane and direction of plunge

Strike and dip of beds, 13-dip of beds in degrees

LOCATION MAP

WYOMING

SCALE

0 1 2 3 4 Miles

N

CENTRAL BIG HORN MOUNTAINS

SISTERS HILL FAULT

N. CRAZY WOMAN SYNCLINE

Crazy Woman Creek System

WEST BILLY CREEK ANTICLINE

BEAVER CREEK ANTICLINE

HORN FAULT

SOUTHERN BIG HORN MOUNTAINS

DIVIDE FAULT

SOUTHERN DIVIDE

BEARTRAP FAULT

FRAKER

RIDDER

MOUNTAIN

MOUNTAIN ANTICLINE

ANTIFERME

LEA MOUNTAIN TENTCLINE

Powder River System

T. 49 N.
T. 48 N.
T. 47 N.
T. 46 N.
T. 45 N.
T. 44 N.

R. 86 W.
R. 85 W.
R. 84 W.
R. 83 W.
R. 82 W.

T. 39 N.

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GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

JUNE, 1976

PLATE 6

EAST FLANK BIG HORN MOUNTAINS
MIDDLE FORK POWDER RIVER
DRAINAGE AND ADJACENT AREAS
43°45'N. TO 43°15'N.

COMPILED BY

Peter Huntoon
James W. Sears
Bruce D. Wilson
R.M. Wolf

WYOMING WATER RESOURCES RESEARCH INSTITUTE

LOCATION MAP

WYOMING

N

LEGEND

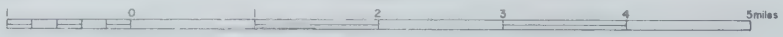
ROCK UNITS

TQu	Undifferentiated Tertiary and Quaternary Rocks
PMu	Undifferentiated post-Tensleep Rocks
PPt	Tensleep Sandstone
MPa	Amsden Formation
Mm	Madison Limestone
OMm	Undivided Madison Limestone and Bighorn Dolomite
€u	Undifferentiated Cambrian Rocks
p€u	Undifferentiated Precambrian Rocks

SYMBOLS

- U / D — Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side
- Thrust fault, dotted where inferred, teeth on upper plate
- Anticline, shows trace of axial plane and direction of plunge
- Monoclinal fold
- 13 — Strike and dip of beds, 13-dip of beds in degrees

SCALE



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Cheyenne, Wyoming
GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
3rd West Regional Commission
Grant No. 10470021

PLATE 5
EAST FLANK BIG HORN MOUNTAINS
MIDDLE FORK POWDER RIVER
DRAINAGE AND ADJACENT AREAS
43°45'N TO 43°15'N

COMPILED BY
Peter Huntoon
James W Sears
Bruce D Wilson
R M Wolf
WYOMING WATER RESOURCES RESEARCH INSTITUTE

LEGEND

ROCK UNITS

TQu	Undifferentiated Tertiary and Quaternary Rocks
PMu	Undifferentiated post Tensleep Rocks
Pt	Tensleep Sandstone
MPa	Amsden Formation
Mm	Madison Limestone
DMm	Undivided Madison Limestone and Bighorn Dolomite
€u	Undifferentiated Cambrian Rocks
pCu	Undifferentiated Precambrian Rocks

SYMBOLS

- Fault: dashed where inferred, dotted where concealed, U-upthrown side, D downthrown side
- Thrust fault, dotted where inferred, teeth on upper plate
- Anticline: shows trace of axial plane and direction of plunge
- Monocline: fold
- Strike and dip of beds, 15 dip of beds in degrees

N

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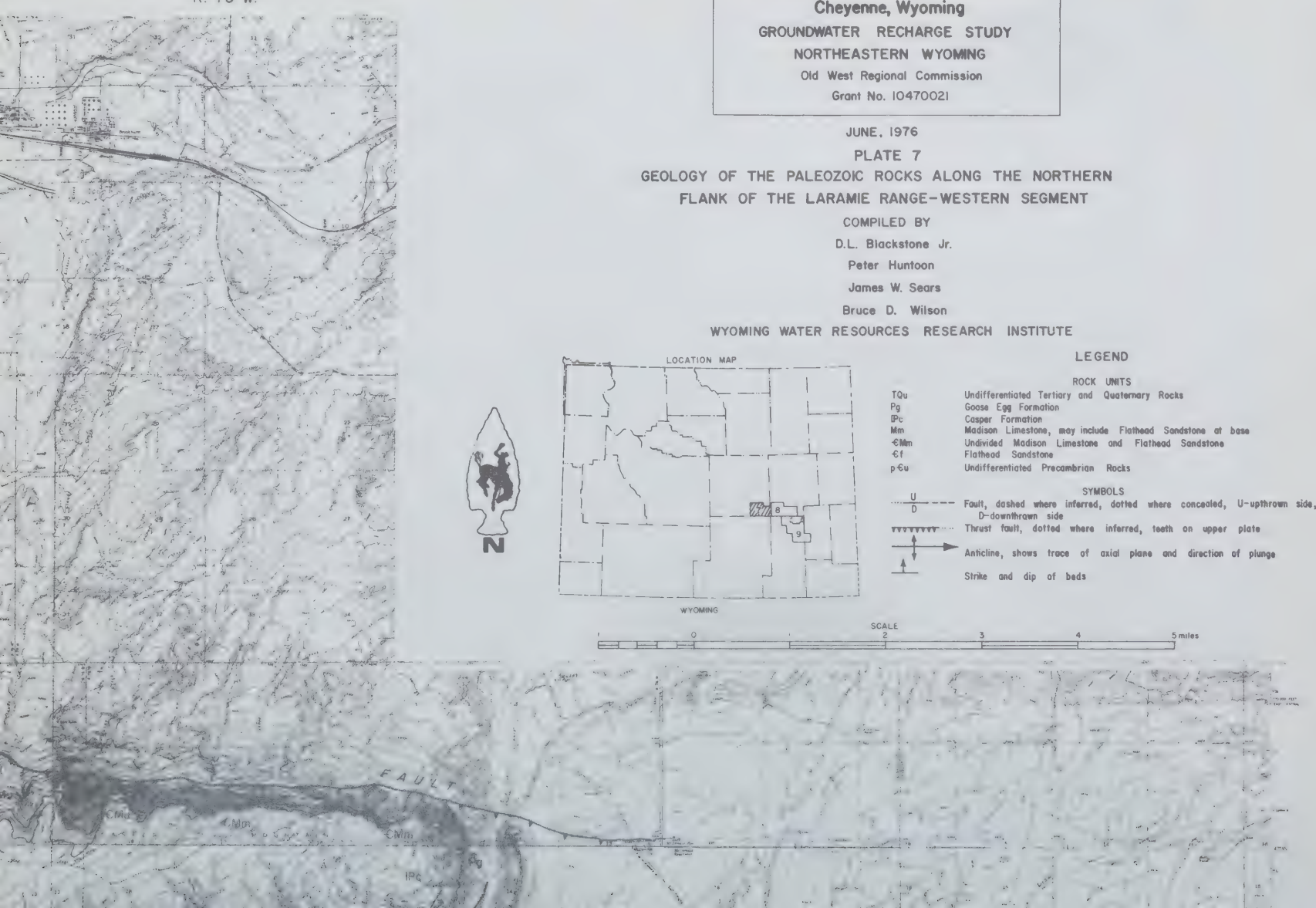
Cheyenne, Wyoming
GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

JUNE, 1976

PLATE 7

GEOLOGY OF THE PALEOZOIC ROCKS ALONG THE NORTHERN FLANK OF THE LARAMIE RANGE-WESTERN SEGMENT

COMPILED BY
D.L. Blackstone Jr.
Peter Huntoon
James W. Sears
Bruce D. Wilson
WYOMING WATER RESOURCES RESEARCH INSTITUTE



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NORTHEASTERN WYOMING
208 Area Report
Grant No. 1047002

JUNE, 1976

PLATE 7

GEOLOGY OF THE PALEOZOIC ROCKS ALONG THE NORTHERN FLANK OF THE LARAMIE RANGE–WESTERN SEGMENT

COMPILED BY

D.L. Blackstone Jr
Peter Huntoon
James W. Sears
Bruce D. Wilson

WYOMING WATER RESOURCES RESEARCH INSTITUTE

LOCATION MAP

LEGEND

ROCK UNITS

TOu	Undifferentiated Tertiary and Quaternary Rocks
Pg	Goose Egg Formation
Pk	Casper Formation
Mm	Madison Limestone (may include Flathead Sandstone at base
CMm	Undivided Madison Limestone and Flathead Sandstone
Cf	Flathead Sandstone
p Cu	Undifferentiated Precambrian Rocks

Fault, dashed where inferred, dotted where concealed, U=upthrown side, D=downthrown side

Anticline, shows trace of axial plane and direction of plunge

Strike and dip of beds

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GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

JUNE, 1976

PLATE 8

GEOLOGY OF THE PALEOZOIC ROCKS ALONG THE NORTHERN FLANK OF THE LARAMIE RANGE-CENTRAL SEGMENT

COMPILED BY

D.L. Blackstone Jr.

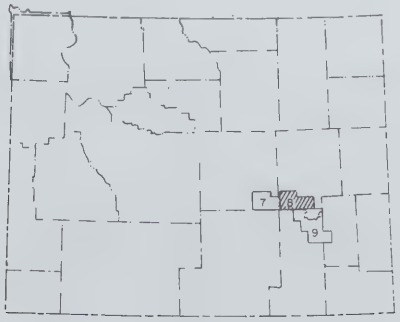
Peter Huntoon

James W. Sears

Bruce D. Wilson

WYOMING WATER RESOURCES RESEARCH INSTITUTE

LOCATION MAP



WYOMING

N

LEGEND

ROCK UNITS

TQu	Undifferentiated Tertiary and Quaternary Rocks
Mu	Undifferentiated Mesozoic Rocks
Pg	Goose Egg Formation
IPc	Casper Formation
Mm	Madison Limestone, may include Flathead Sandstone at base
€f	Flathead Sandstone
p€	Precambrian Rocks

SYMBOLS

U/D — Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side

Thrust fault, dotted where inferred, teeth on upper plate

Anticline, shows trace of axial plane and direction of plunge

Syncline, shows trace of axial plane and direction of plunge

Strike and dip of beds

SCALE

0 1 2 3 4 5 miles

R. 73 W. R. 72 W R. 71 W.

WYOMING STATE ENGINEER
Cheyenne, Wyoming
GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No 10470021

JUNE 976

PLATE 8

GEOLOGY OF THE PALEOZOIC ROCKS ALONG THE NORTHERN FLANK OF THE LARAMIE RANGE-CENTRAL SEGMENT

COMPILED BY
D.L. Blackstone Jr
Peter Huntoon
James W Sears
Bruce D. Wilson
WYOMING WATER RESOURCES RESEARCH INSTITUTE

LEGEND

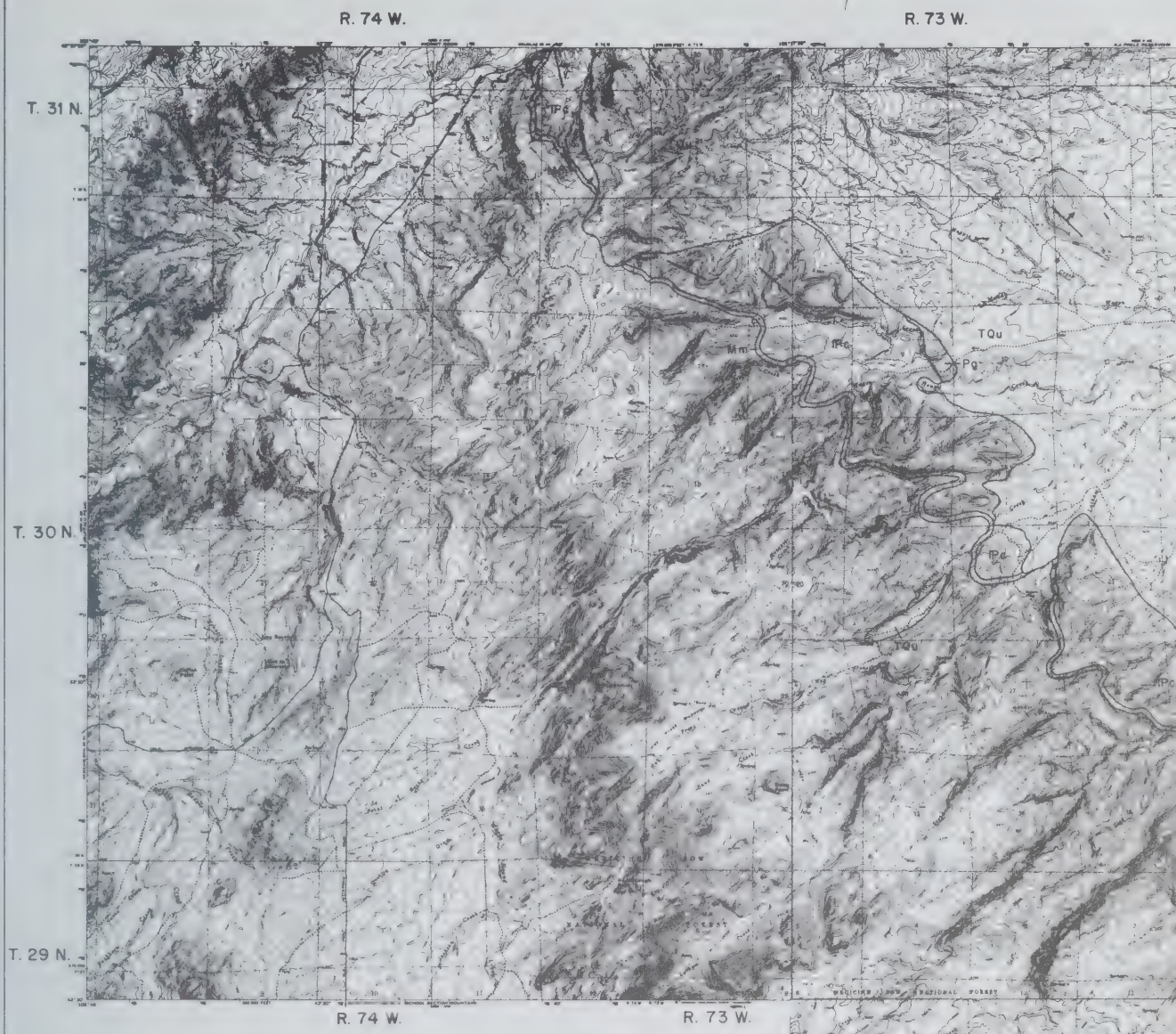
LOCATION MAP

ROCK UNITS

- Tpu Undifferentiated Tertiary and Quaternary Rocks
- Mu Undifferentiated Mesozoic Rocks
- Kg Goose Egg Formation
- P Casper Formation
- Mm Madison Limestone, may include Flathead Sandstone at base
- Cf Flathead Sandstone
- p Precambrian Rocks

SYMBOLS

- Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side
- Thrust fault, dotted where inferred, teeth on upper plate
- Anticline, shows trace of axial plane and direction of plunge
- Syncline, shows trace of axial plane and direction of plunge
- Strike and dip of beds



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Cheyenne, Wyoming
GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

T. 29 N.

JUNE 1976

PLATE 9
GEOLOGY OF THE PALEOZOIC ROCKS ALONG THE NORTHERN FLANK OF THE LARAMIE RANGE – EASTERN SEGMENT

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Old West Regional Commission
Grant No. 1047002I

JUNE 1976

PLATE 9
GEOLOGY OF THE PALEOZOIC ROCKS ALONG THE NORTHERN FLANK OF THE LARAMIE RANGE – EASTERN SEGMENT

COMPILED BY
D L Blackstone Jr
Peter Huntoon
James W Sears
Bruce D Wilson
WYOMING WATER RESOURCES RESEARCH INSTITUTE

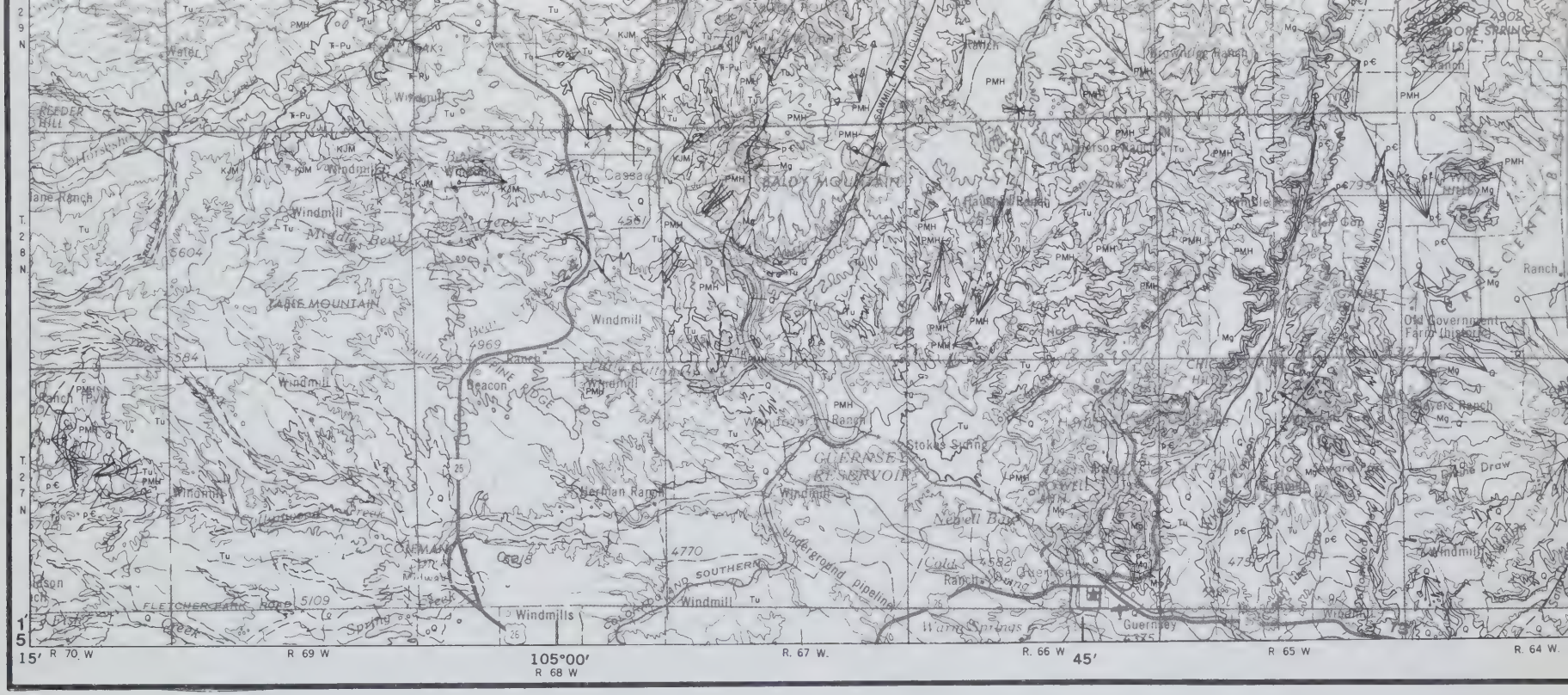
LEGEND

ROCK UNITS

Tgu	Undifferentiated Tertiary Rocks
Kgg	Goose Egg Formation
Pc	Casper Formation
Mm	Madison Limestone, may include Flathead Sandstone at base
Ca	Precambrian Rocks

SYMBOLS

- Fault, dashed where inferred, dotted where concealed, U-upthrown side, D-downthrown side
- Thrust fault, dotted where inferred, teeth on the upper plate
- Anticline, shows trace of axial plane and direction of plunge
- Syncline, shows trace of axial plane and direction of plunge
- Strike and dip of beds



SCALE

5 0 5 10 15 20

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GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

PLATE 10

SURFACE GEOLOGY MAP OF THE HARTVILLE HILLS AREA, WYOMING

June, 1975

Project Leader A.J. Mancini
Drafted by D.E. Woodhams

Qal	Alluvial material; stream deposits.
Q	Dune sand.
Tmo	Miocene and Oligocene Rocks.
Tm	Miocene Arikaree Formation.
Twr	White River Group.
Tbr	Brule Formation.
Kfh	Fox Hills Formation.
KJm	Undivided Cretaceous Dakota Sandstone, Cloverly Formation, and Jurassic Morrison Formation.
IPh	Hartville Formation, undivided.
Mg	Guernsey Formation.
p€	Precambrian Igneous and Metamorphic Rocks.
	Formation absent.
	Formation present but not shown on map.

CORRELATIONS

		Plate I	This Plate
	Quaternary	Qal Qs	Q
	Tertiary	Tmo Tm Twr Tbr	Tu
		Tfu	Tfu
MESOZOIC	Cretaceous	Kfh	K
		KJm	KJM
	Jurassic		Ju
	Triassic		TR-Pu
PALEOZOIC	Permian	IPh	PMH
	Pennsylvanian		
	Mississippian	Mg	Mg
	Devonian		
	Ordovician		€
	Cambrian		
	Precambrian	p€	p€

Geology modified from maps submitted by John P. Albaness, consultant

Q	Quaternary undivided.
Tu	Tertiary younger than Fort Union Formation.
Tfu	Fort Union Formation.
K	Cretaceous Rocks below Fox Hills and above C undivided.
KJM	Undivided Cretaceous Dakota Sandstone, Clover Jurassic Morrison Formation.
Ju	Undivided Jurassic Sundance Formation; Jurassi Morrison Formation.
TR-Pu	Triassic-Permian sequence, undivided.
PMH	Hartville Formation.
Mg	Guernsey Formation.
€	Cambrian Sandstone.
p€	Precambrian Igneous and Metamorphic Rocks.
	Formation absent.

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NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 104700021

PLATE 10

SURFACE GEOLOGY MAP OF THE HARTVILLE HILLS AREA, WYOMING

June, 1976

Project under the supervision of A. L. Mahon
Drafted by O. E. Knochenmus

0 5 10 15 20 25 miles

Qal Alluvial material, stream deposits
Q Dune sand
Tmo Miocene and Oligocene Rocks
Tm Miocene Arikaree Formation
Tw White River Group
Tfu Brule Formation
Kfh Fox Hills Formation
Kdm Undivided Cretaceous Dakota Sandstone, Clenarly Formation, and Jurassic Morrison Formation
Jhs Horsethe Formation, undivided
Jg Guernsey Formation
pC Precambrian Igneous and Metamorphic Rocks
Formation absent
Formation present but not shown on map

CORRELATIONS

Era	System	Plate 1 Unit	This Plate
CENOZOIC	Quaternary	Qal	Q
	Tertiary	Tm, Tw, Tfu	T_u
		Tm	T_{mo}
MESOZOIC	Cretaceous	Kfh	Kfh
		Kdm	Kdm
	Jurassic	Jm	Jm
	Triassic	Jhs	Jhs
PALEOZOIC	Mississippian, Devonian, Ordovician	Mg	Mg
		Ws	Ws
		Cm	Cm
		pC	pC

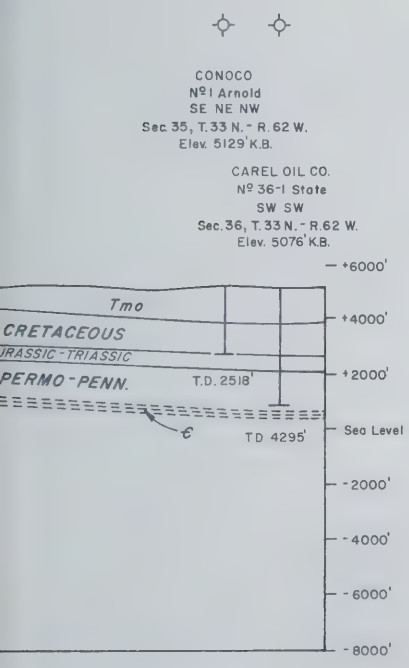
Q Quaternary undivided
T_u Tertiary younger than Fort Union Formation
T_{fu} Fort Union Formation
K Cretaceous Rocks below Fox Hills and above Cloverly or Dakota, undivided
Kdm Undivided Cretaceous Dakota Sandstone, Cloverly Formation, and Jurassic Morrison Formation
Jm Undivided Jurassic Sundance Formation, Nugget Rock below Morrison Formation
$\frac{J}{TR}$ P_u Triassic Permian sequence undivided
Jhgm Hartville Formation
Mg Guernsey Formation
€ Cambrian Sandstone
pC Precambrian Igneous and Metamorphic Rocks
Formation absent

N

WYOMING

SE C'

ESBURG BASIN



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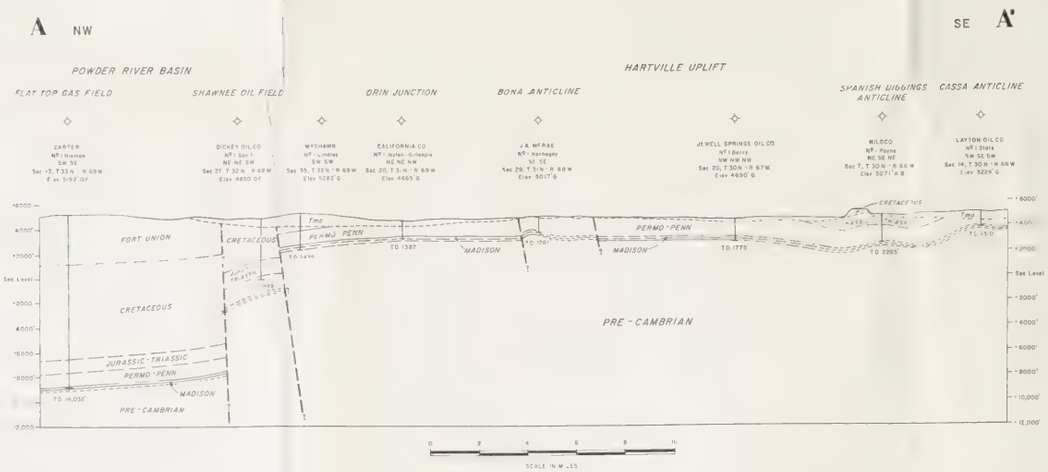
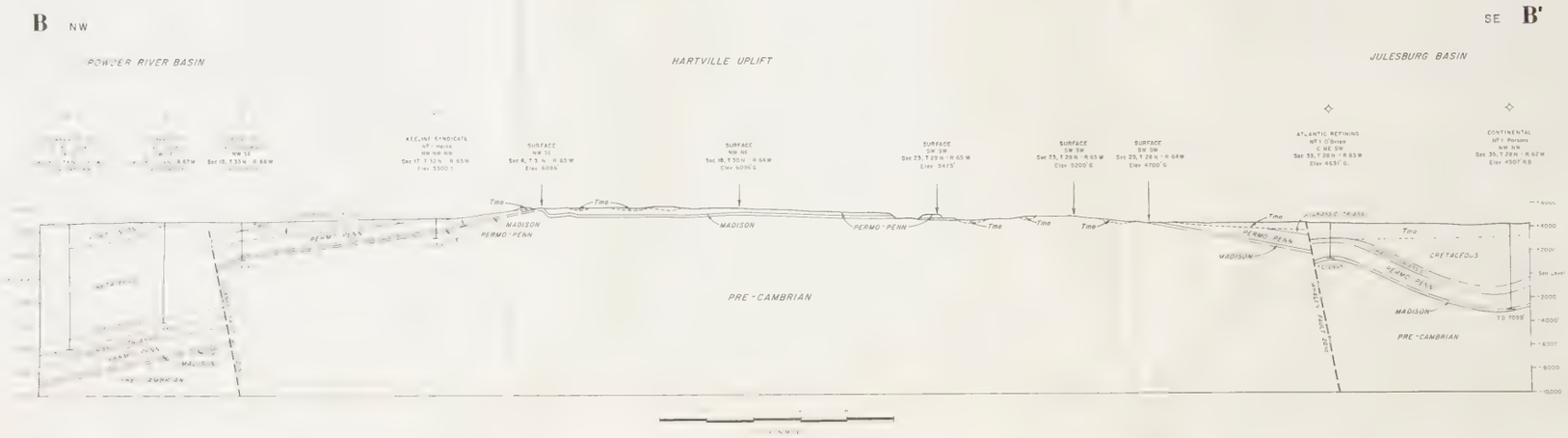
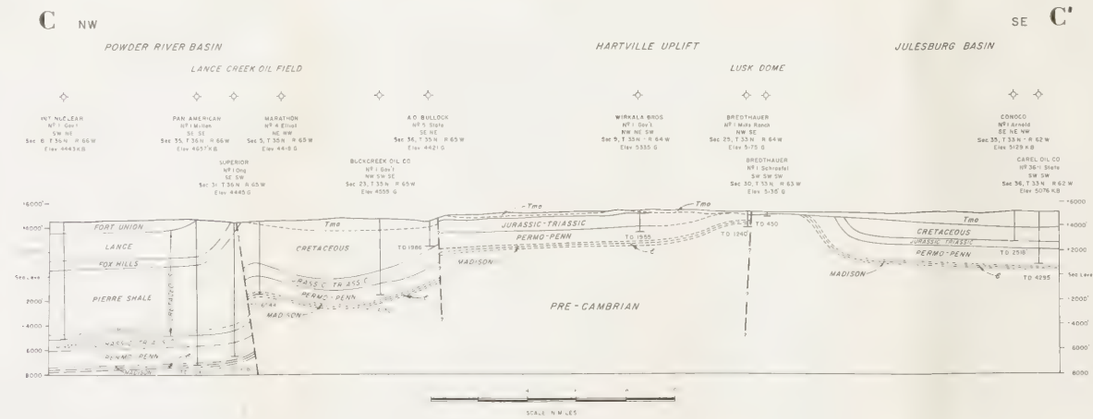
Grant No. 10470021

PLATE II







HARTVILLE UPLIFT AREA, WYOMING

STRUCTURAL CROSS SECTIONS

LINE OF CROSSECTIONS SHOWN ON FIGURE 18 (TECTONIC MAP)

Geology by John Albanese

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Grant No 10470021

PLATE II

PLATE 12-- LOCATION MAPS FOR GAGING STATIONS AND MISCELLANEOUS MEASURING SITES

showing specific drainage basins

June, 1976

Project Leader - A. J. Mancini

Drafted By- D.E. Woodhams

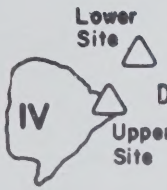
Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

LEGEND



Drainage Basin

A,9 Measuring site, basin not shown

GAGING STATIONS

△ Installed as part of Groundwater Recharge Study

▲ Installed as part of State Engineer–U.S.G.S. Cooperative Program

◬ Installed as part of another program

▽ Installed in springhouse near Douglas

MISCELLANEOUS MEASURING SITES

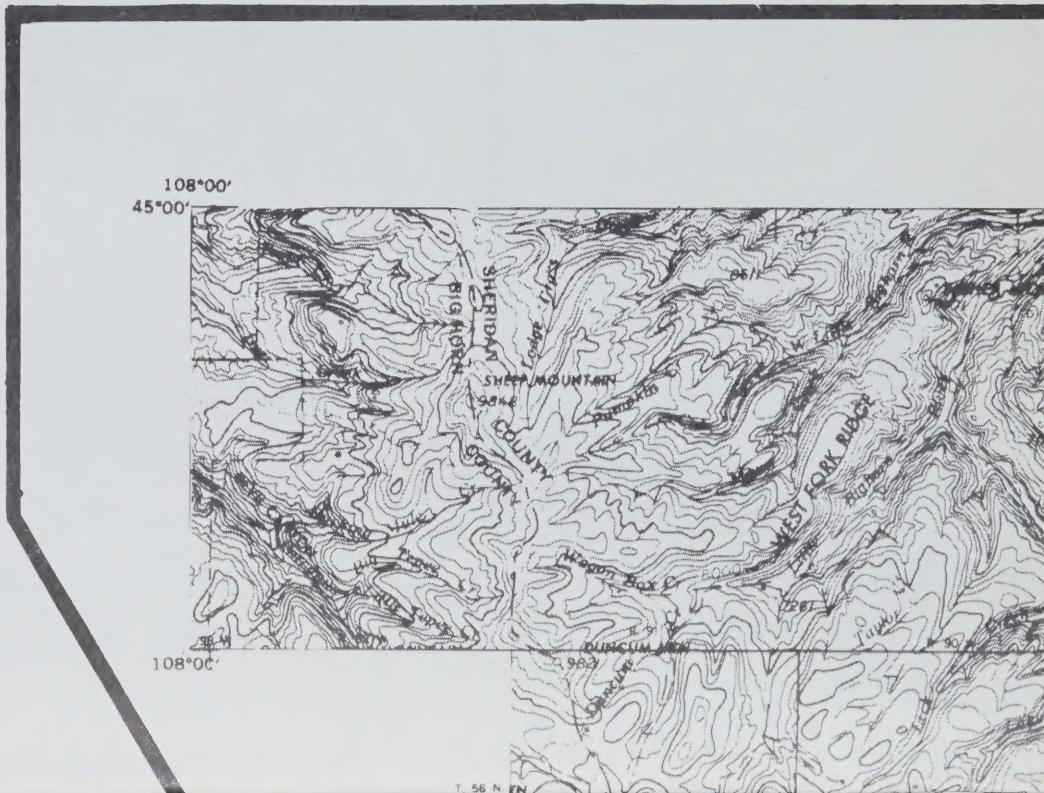


PLATE 12-- LOCATION MAPS FOR GAGING STATIONS AND MISCELLANEOUS MEASURING SITES

showing specific drainage basins

June, 1976

Project Leader - A.J. Mancini
Drafted By - D.E. Woodhams

WYOMING STATE ENGINEER
Cheyenne, Wyoming
GROUNDWATER RECHARGE STUDY
NORTHEASTERN WYOMING
Old West Regional Commission
Grant No. 10470021

Scale 1:250,000

5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
5 0 5 10 15 Nautical Miles

LEGEND

Lower Site △
IV — Drainage Basin
Upper Site

A,9 — Measuring site, basin not shown

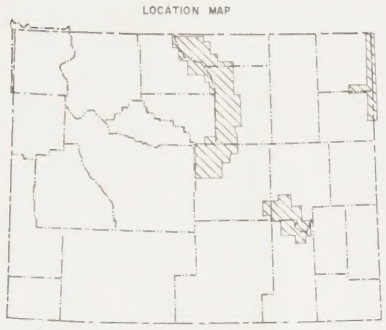
GAGING STATIONS

△ Installed as part of Groundwater Recharge Study
▲ Installed as part of State Engineer-U.S.G.S. Cooperative Program
△ Installed as part of another program
▽ Installed in springhouse near Douglas

MISCELLANEOUS MEASURING SITES

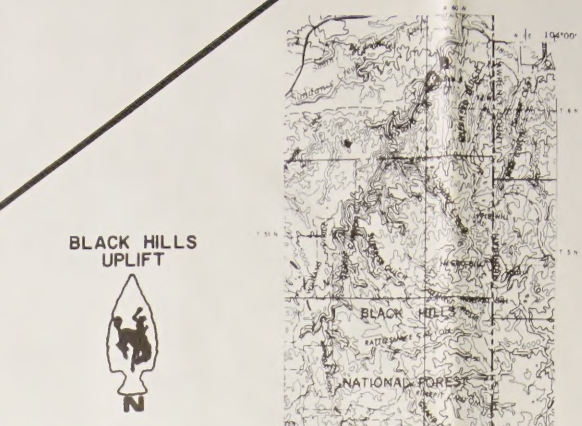
■ Five or more measurements
□ Less than five measurements

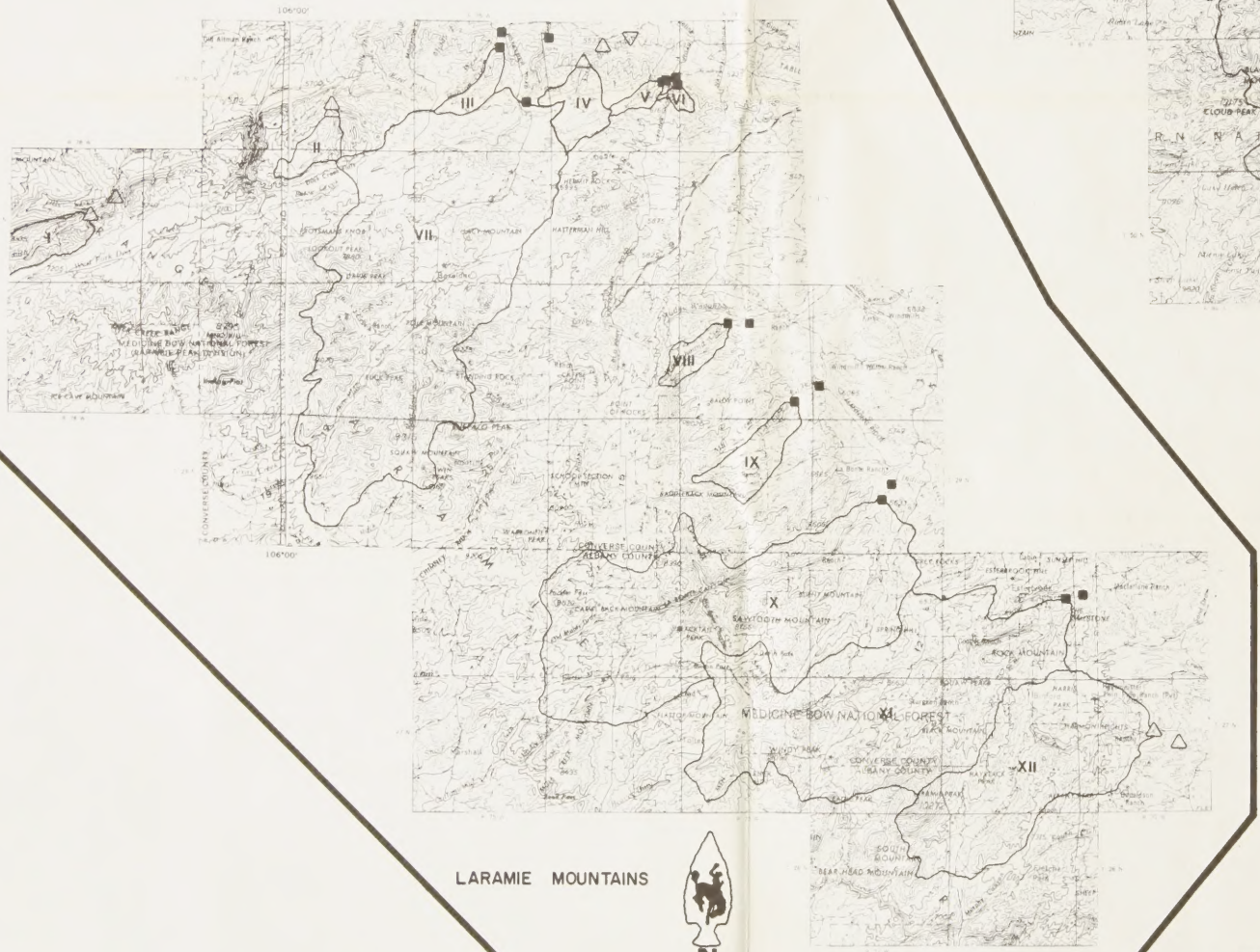
LOCATION MAP



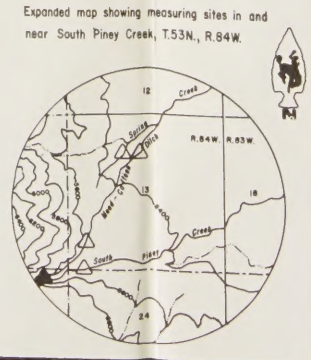
WYOMING

BLACK HILLS UPLIFT





Expanded map showing measuring sites in and near South Piney Creek, T.53N., R.84W.



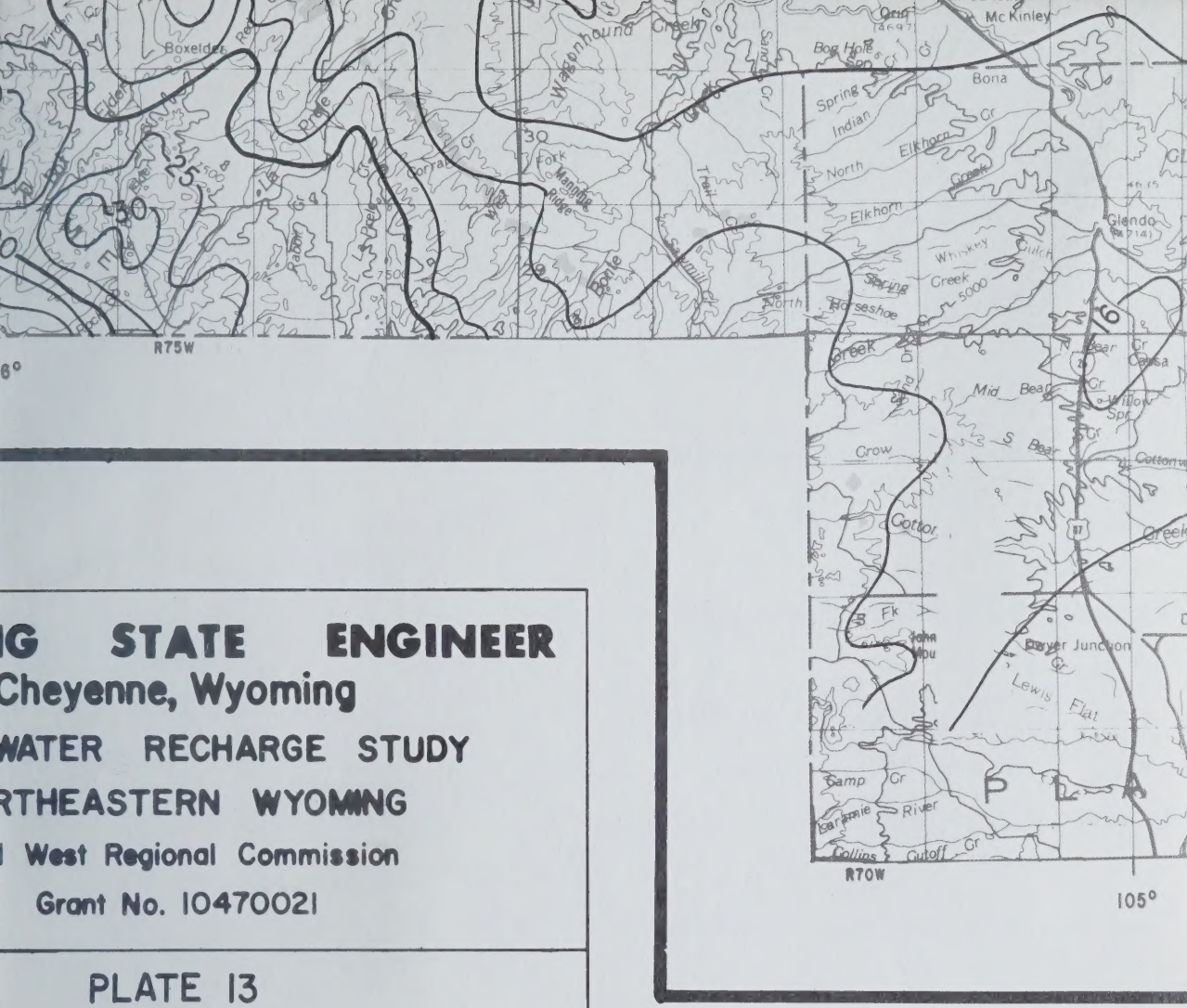
Drainage Basins

I. Smith Ck
II. Little Deer Ck
III. Hunton Ck
IV. Little Box Elder Ck
V. Cottonwood Ck
VI. Spring Canyon Ck
VII. Box Elder Ck
VIII. Wagon Hound Ck
IX. West Fork La Bonte Ck
X. La Bonte Ck
XI. Horseshoe Ck
XII. Cottonwood Ck
XIII. South Fork West Pass Ck
XIV. West Fork Taffner Ck
XV. East Pass Ck
XVI. Columbus Ck
XVII. Smith Ck
XVIII. Tongue
XIX. Little Tongue
XX. South Fork Little Tongue
XXI. Wolf Ck
XXII. Soldier Ck
XXIII. Big Goose Ck
XXIV. Rapid Ck
XXV. North Piney Ck
XXVI. South Piney Ck
XXVII. North Rock Ck
XXVIII. South Rock Ck
XXIX. North Fork Sayles Ck
XXX. Johnson Ck
XXXI. French Ck
XXXII. Clear Ck
XXXIII. Little North Fork Crazy Woman Ck
XXXIV. Unamed Tributary to North Fork Crazy Woman Ck
XXXV. North Fork Crazy Woman Ck
XXXVI. North Fork Powder
XXXVII. Muddy Ck
XXXVIII. Billy Ck
XXXIX. Poison Ck
XL. Middle Fork Crazy Woman Ck
XLI. Beaver Ck
XLII. Deartrap Ck
XLIII. North Fork Red Fork Powder
XLIV. South Fork Red Fork Powder
XLV. Beaver Ck
XLVI. Middle Fork Powder
XLVII. North Fork Buffalo Ck
XLVIII. Pine Ck
XLIX. Buffalo Ck
L. Little Goose Ck

Measuring Site, Basin Not Shown

A. Inyan Kara Ck
B. Sand Ck
C. Cold Springs Ck
D. Stockade Beaver Ck (Upper)
E. Stockade Beaver Ck (Lower)

1. Elkhorn Ck
2. Red Gulch
3. Gay Ck
4. North Fork West Pass Ck
5. South Smith Ck
6. Little Piney Ck
7. Mowry Ck
8. South Fork Sayles Ck
9. Dry Muddy Ck
10. South Fork Crazy Woman Ck
11. Blue Ck
12. Eagle Ck
13. First Water Draw
14. First Water Ck
15. North Cottonwood Ck



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Grant No. 10470021

PLATE 13
PRECIPITATION MAP
RTHEASTERN WYOMING

June, 1976

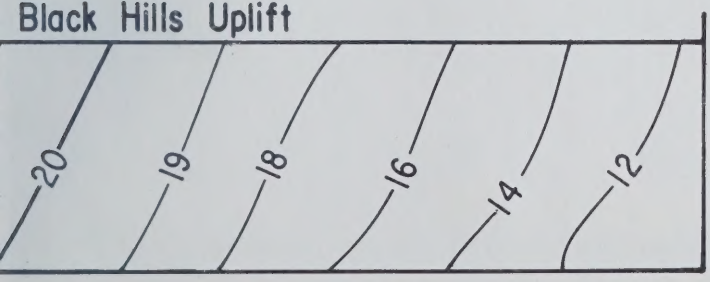
Project Leader A.J. Mancini

Drafted by D.E. Woodhams

10

N

Black Hills Uplift



M O N T A N A

S O U T H D A K O T A

N E B R A S K A

SHERIDAN

JOHNSON

CAMPBELL

CROOK

WASHAKIE

HOT SPRINGS

WESTON

NATRONA

CONVERSE

NIOBRARA

GOSHEN

PLATTE

Sheridan

Buffalo

Gillette

Worland

Newcastle

CASPER

Douglas

Wheatland

Torrington

Lusk

Glenrock

Mountain View

Midwest

Edgerton

Powder River

Salt Creek

Bear Creek

Cheyenne River

Beaver Creek

Lance Creek

Hat Creek

Pine Tree

Recluse

Soda Well

Wildcat

Carlile

Upton

Clay Spur

Osage

Clareton

Rochelle

Hampshire

Redbird

Kaycee

Barnum

Meadow Creek

Ross

Verse

Dogie

Leverett

Cow Creek

Janet

Bill

Douglas

Keeline

Node

Van Tassell

Prairie Center

Meadowdale

Glenrock Reservoir

Pine Ridge

Fort Laramie

Guernsey

Hawk Springs

Granite Mountains

Laramie Mountains

Casper Mountain

Stone Mt.

Sand Hills

Spoon Butte

Lance Creek

Redbird

Bright

Kuttler

Whitman

Spencer

Thompson Fork

Four Corners

Sundance

Horton

Bull Creek

Jerome

Reva

Padco

Lewder

Highland

Savageton

Kara Junction

Wright

Pine Tree

Tumbleweed

Weckla

Ross

Midwest

Edgerton

Verse

Dull Center

Guthrie

Bear Creek

Bill

Janet

West Lance Creek

Lance Creek

Hat Creek

Whitman

Kuttley

Node

Van Tassell

Prairie Center

Meadowdale

Glenrock Reservoir

Pine Ridge

Fort Laramie

Guernsey

Hawk Springs

Granite Mountains

Laramie Mountains

Casper Mountain

Stone Mt.

Sand Hills

Spoon Butte

Lance Creek

Redbird

Bright

Kuttley